LCD MODULE

SPECIFICATION

Model:	HD040WV-RB40-A061A
Version:	V1.0
Date:	20210107

Customer Confirmation 客户确认

Approved by	Notes

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VIEWE Confirmation 优奕确认

Prepared by	Reviewed by	Approved by

REVISION HISTORY

Revision 版本号	Date 日期	Contents of Revision Change 修改内容	Remark 备注
V1.0	20210107	Preliminary release	

TABLE of CONTENTS

1. GENERAL INFORMATION

1.1 Features

1) Pixel Arrangement：RGB Vertical Stripe
2) Interface Mode： RGB 24Bits
3) Driver IC： GC9503V；Touch IC：HY4633
4) Operation Temperature：-20~85℃(4Hours)
5) Storage Temperature：-30~85℃(4Hours)
6) Backlight Type：White LED
7) Display mode：Normally Black
8) Pixel Density：266 PPI
9) LED life time：30,000 Hours

1.2 Mechanical Specification

Item 项目	Specification 规格	Unit 单位	Remark 备注
Pixel Driving element	IPS TFT	-	-
Screen Size	3.99	Inch	Diagonal
Resolution	400(W)*3(RGB)*960(H)	Dots	-
Interface	4 wire SPI RGB	-	24Bits
Module Power Consumption	0.6715	Watt	Typ.
Active Area	39.18(W)*94.032(H)	mm	-
Pixel pitch (W*H)	32.65(W)*97.95(H)	um	-
CTP_Module Size (W*H*D)	46.5(W)*106.08(H)*2(D)	mm	Typ
Luminance	350	cd/m^2	Typ.
Viewing Direction	ALL	O'clock	
Display Color	16.7M	Colors	24bits

2. ABSOLUTE MAXIMUM RATINGS

Item 项目	Symbol 符号	Min. 最小值	Max. 最大值	Unit 单位	Remark 备注
Power supply1 voltage	VDD	-0.3	4.6	V	Note1
Power supply2 voltage	VDD 3.3V	-0.2	4.0	V	
LED forward current	I_F	-0.001	20	mA	For each led,Note1
LED Reverse Voltage	V_R	-	5	V	For each led,Note1
Operating temperature	T_{op}	-20	85	℃	(4Hours)Note1,2
Storage temperature	T_{st}	-30	85	℃	(4Hours)Note1,2
Humidity	H_{st}	10	90	%RH	Note1,3

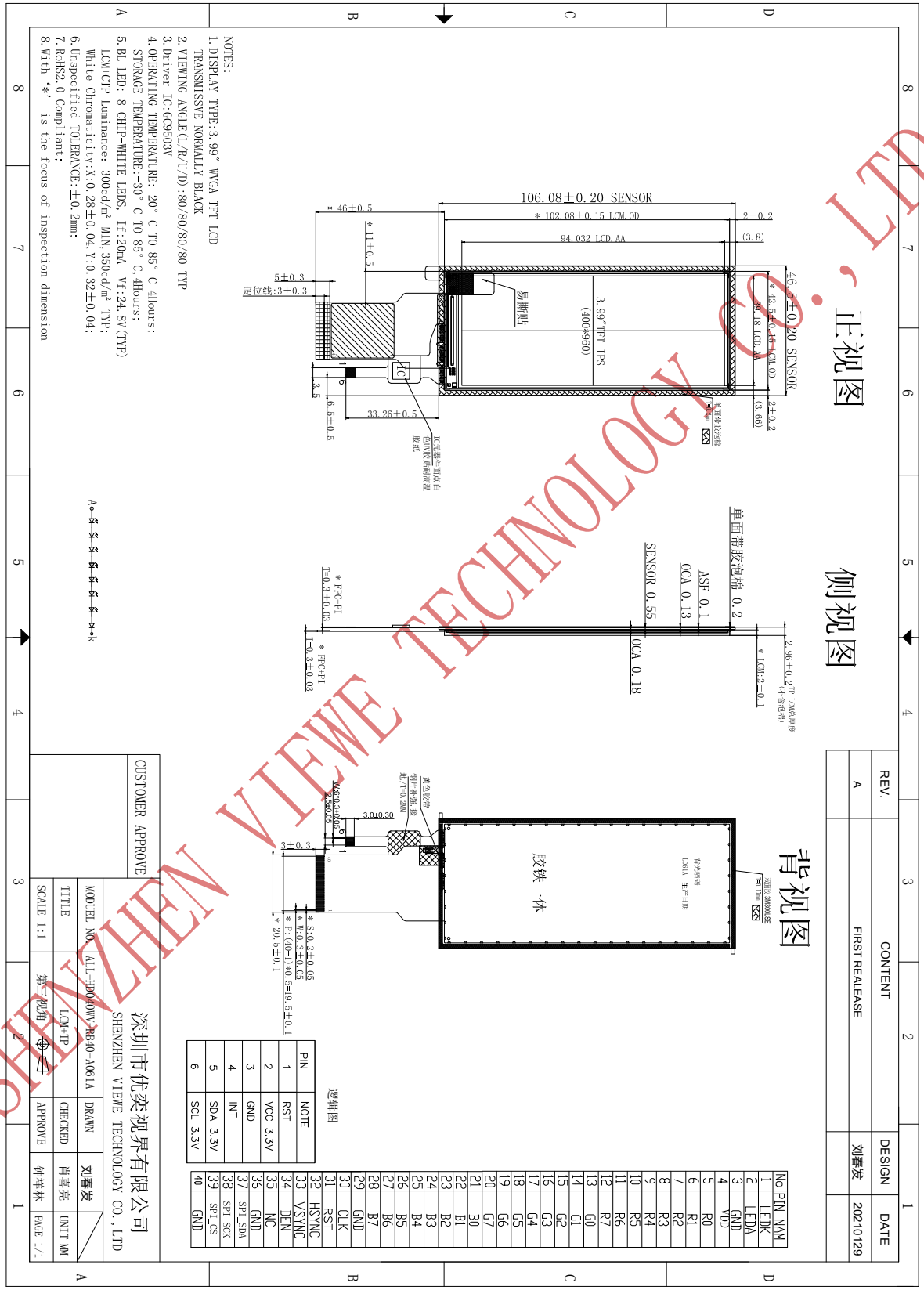
(Ta=+25°C,GND=0V)

Note1:If the module exceeds the absolute maximum ratings, it may be damaged permanently. Also if the module operates with the absolute maximum ratings for a long time, the reliability may drop.

Note2: In case of temperature below 0℃,the response time of liquid crystal (LC) becomes slower and the color of panel darker than normal one.

Note3: Temp. ≤ 60℃ , 90% RH MAX.
Temp. ＞60℃ , Absolute humidity shall be less than 90% RH at 60℃.

3. MECHANICAL DRAWING



4. I/O CONNECTION & BLOCK DIAGRAM

4.1 I/O Connection

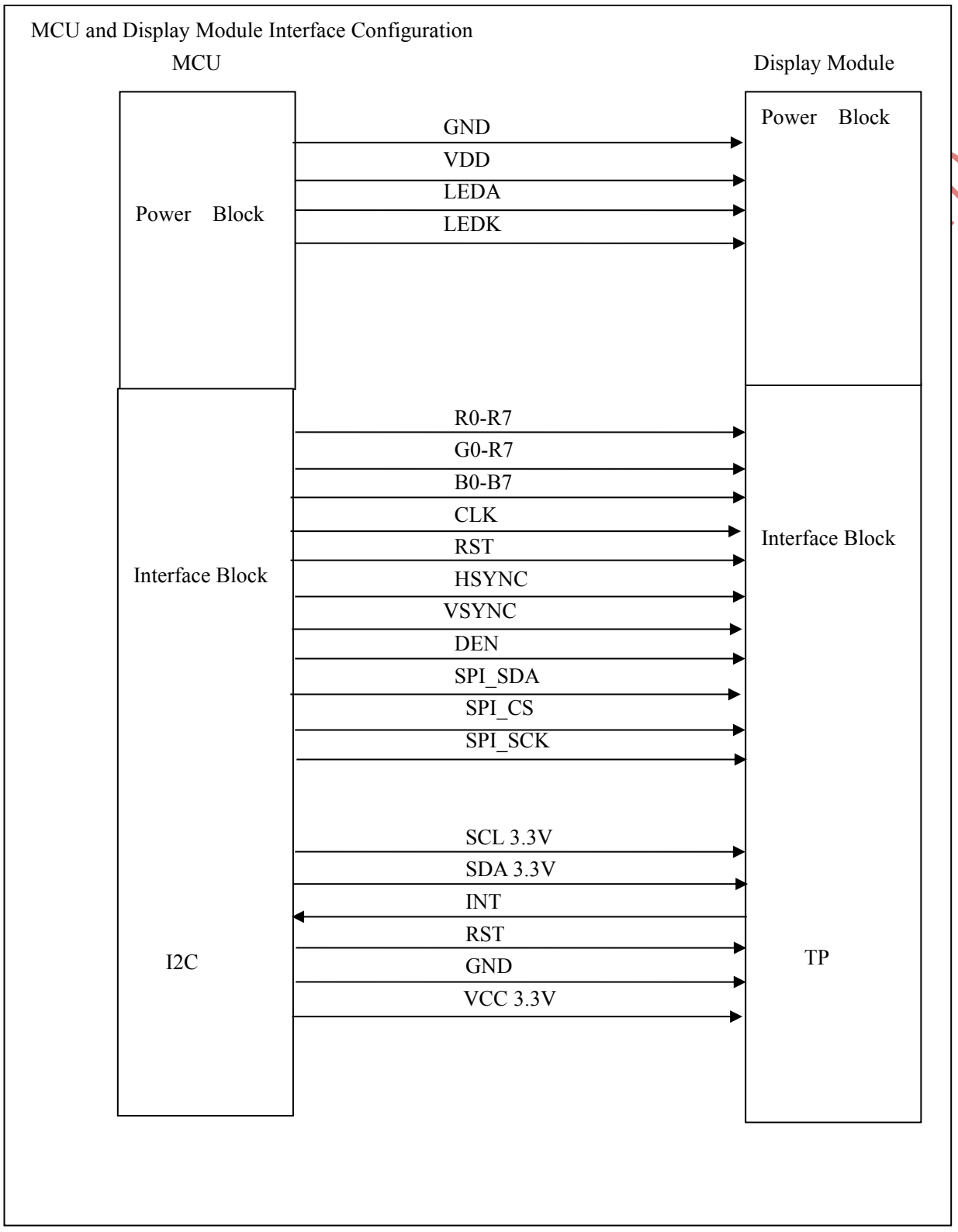
Pin No. 序号	Symbol 符号	I/O	Description 描述
1	LEDK	P	Power supply for backlight cathode
2	LEDA	P	Power supply for backlight anode
3	GND	P	Power Ground
4	**VDD**	P	Power supply for analog circuits
5-12	**R0-R7**	I	Red data input.(R0-LSB;R7-MSB)
13-20	**G0-G7**	I	Green data input.(G0-LSB;G7-MSB)
21-28	**B0-B7**	I	Blue data input.(B0-LSB;B7-MSB)
29	**GND**	P	Power Ground
30	**CLK**	I	Dot clock signal for RGB interface operation
31	**RST**	I	The signal will reset the LCM, Signal is active low.
32	**HSYNC**	I	Horizontal sync signal, Negative polarity
33	**VSYN C**	I	Horizontal sync signal, Negative polarity
34	**DEN**	I	Data input enable. Display access is enabled when DE is "H"
35	**NC**	-	No connected
36	**GMD**	P	Power Ground
37	**SPI_SDA**	I/O	Data select pin for SPI interface
38	**SPI_SCK**	I	Clock select pin for SPI interface
39	**SPI_CS**	I	Chip select pin for SPI interface
40	**GND**	P	Power Ground

I：Input；O：Output；P：Power

4.2 TP Connection

Pin No. 序号	Symbol 符号	I/O	Description 描述
1	**RST**	I	The signal will reset the TP,Signal is active low
2	**VDD 3.3V**	P	Power supply for TP
3	GND	P	Power Ground
4	INT	0	Interrupt signals for TP
5	SDA 3.3V	I/O	I2C data signal for TP
6	SCL 3.3V	I	I2C clock signals for TP

4.2 Block Diagram



5. ELECTRICAL CHARACTERISTICS

5.1 TFT-LCD Panel Driving Section

Item 项目	Symbol 符号	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Power Supply1 Voltage	VDD	2.5	2.8	3.3	V	-
Power Supply2 Voltage	VCC 3.3V	2.5	3.3	3.6	V	-
Power Supply1 Current	I_{VDD}	-	45	-	mA	Note1
Power Supply2 Current	$I_{VCC\ 3.3V}$		15			
Logic Input High Voltage	V_{IH}	0.7VDD	-	VDD	V	-
Logic Input Low Voltage	V_{IL}	0	-	0.3VDD	V	-
Panel Power Consumption	P_{LCM}	-	0.1755	-	Watt	Note1
Module Power Consumption	P_{ALL}	-	0.6715	-	Watt	Note1,2

(Ta=+25°C,GND=0V)

Note1:Measurement Conditions (Video Mode): Full Screen Red Pattern,VDD=1.8V,60Hz Refresh.

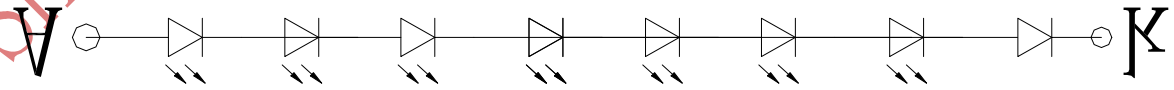
Note2: P_{LCM}= P_{VDD}+ P_{BL}， About P_{BL} information, inference to 5.2 Back Light Driving Section.

5.2 Back Light Driving Section

Item 项目	Symbol 符号	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Forward Voltage	V_F	-	24.8	-	V	Note1
Forward Current	I_F	-	20	-	mA	Note1
Backlight Power consumption	P_{BL}	-	0.69	-	Watt	Note1
LED life time	-	30000	-	-	Hours	Note2
LED Quantity			8		PCS	

(Ta=+25°C,GND=0V)

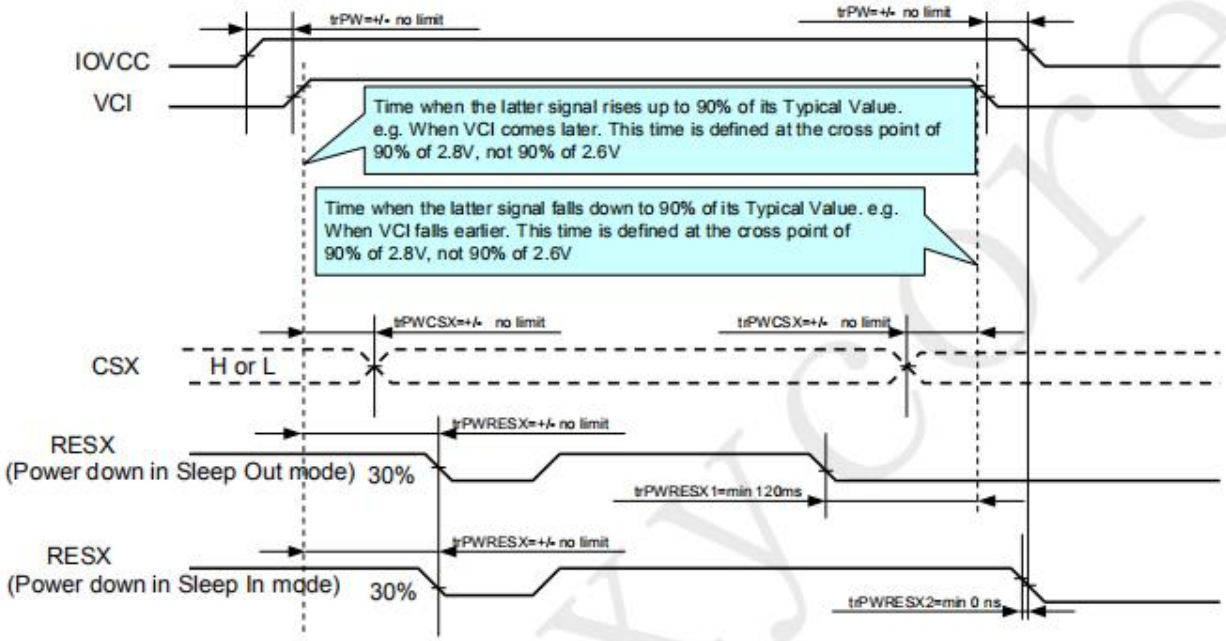
Note1:The “LED life time” is defined as the module brightness decrease to 50% of original brightness at I_{LED}=20mA(Per Led). The LED life time could be decreased if operating I_{LED} is larger than 20mA.



5.3 Power On/Off Sequence

5.3.1 RESX line is held High or Unstable by Host at Power ON

If the RESX line is held high or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and IOVCC have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

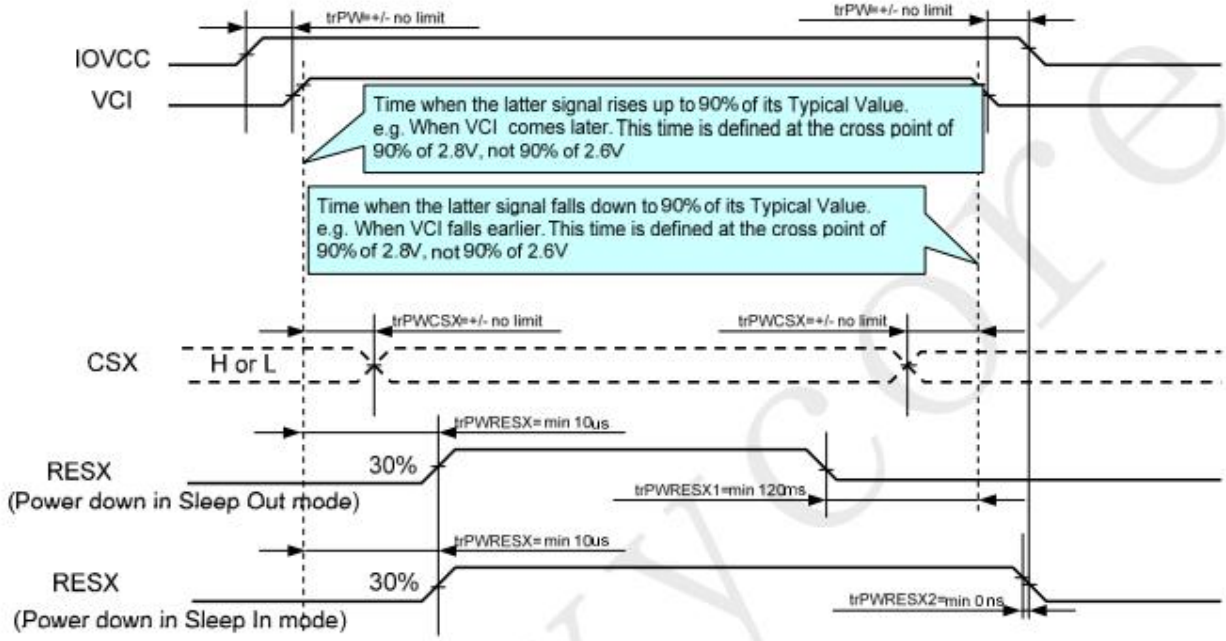


trPWRESX1 is applied to RESX falling in the Sleep Out Mode

trPWRESX2 is applied to RESX falling in the Sleep In Mode

5.3.2 RESX line is held Low by Host at Power ON

If the RESX line is held Low (and stable) by the host during Power On, then the RESX must be held low for minimum 10μsec after both VCI and IOVCC have been applied.



trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

Figure 99 Case 2 – RESX line is held Low by Host at Power ON

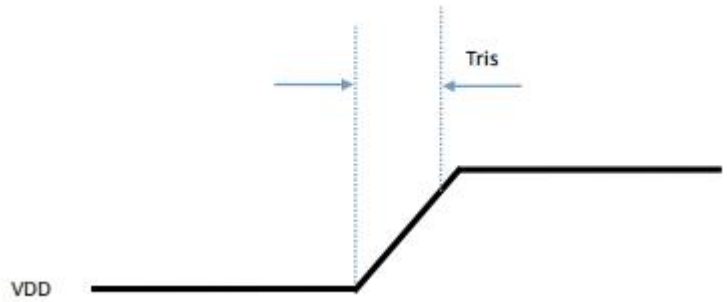
Note: 1. Unless otherwise specified, timings herein show cross point at 50% of signal power level.

5.3.3 Abnormal Power Off

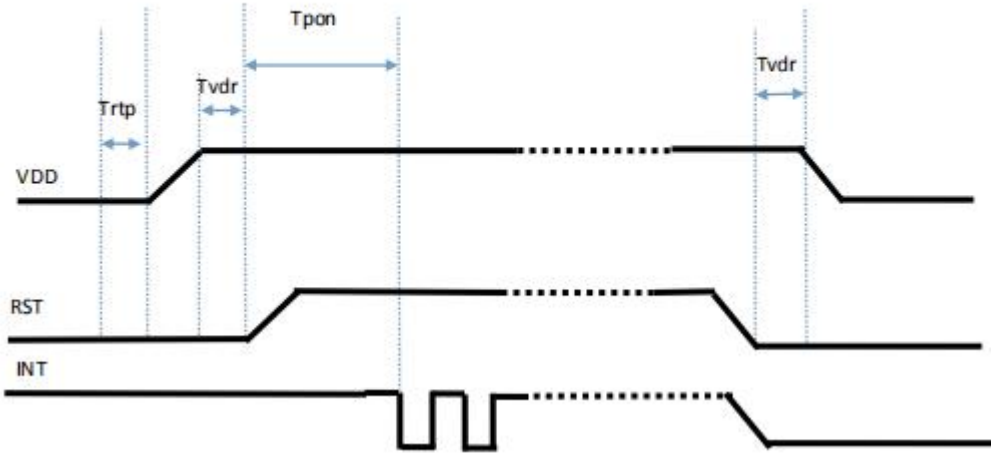
The abnormal power off means a situation when e.g. there is removed a battery without the normal power off sequence. There will not be any damages for the display module or the display module will not cause any damages for the host or lines of the interface. At an abnormal power off event, GC9503V will force the display to blank and will not be any abnormal visible effects with in 1 second on the display and remains blank until “Power On Sequence” powers it up

5.3.4 TP Power Sequence

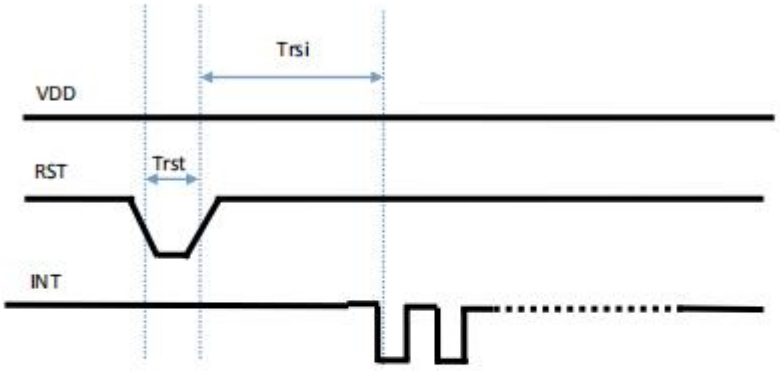
Power Rise Timing:



Power On / Off Timing:



Reset Sequence:



Parameter	Description	Min	Max	Uints
Tris	Rise time from 0.1VDD to 0.9VDD		5	ms
Trtp	Time of resetting to be low before powering on	100		us
Tpon	Time of starting to report point after powering on	200		ms
Tvdr	Reset time after VDD powering on	1		ms
Trsi	Time of starting to report point after resetting	200		ms
Trst	Reset time	2		ms

5.4 interface timings

5.4.0 I2C interface timings

The IIC is always configured in the Slave mode. The data transfer format is showed in the following figure.

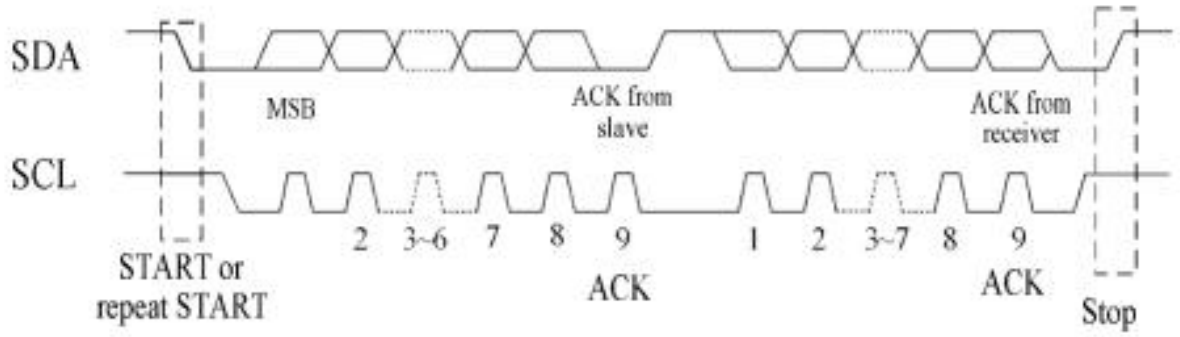


Figure 2-1 IIC Serial Data Transfer Format

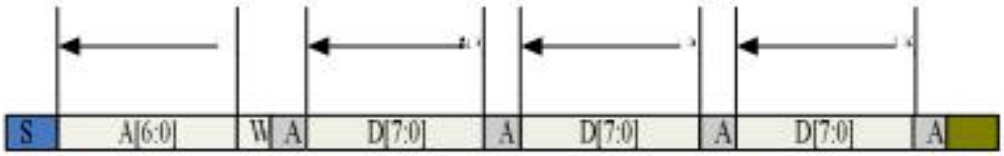


Figure 2-2, I IIC master write, slave read

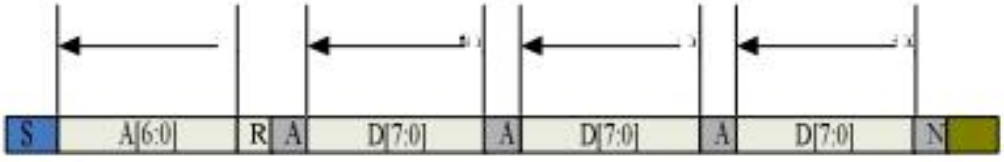
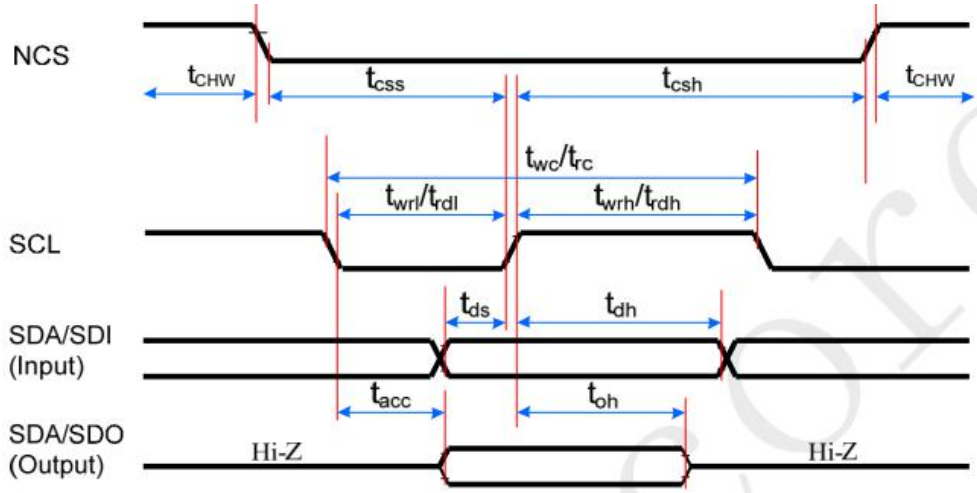


Figure 2-3 IIC master read, slave write

5.4.1AC Characteristics

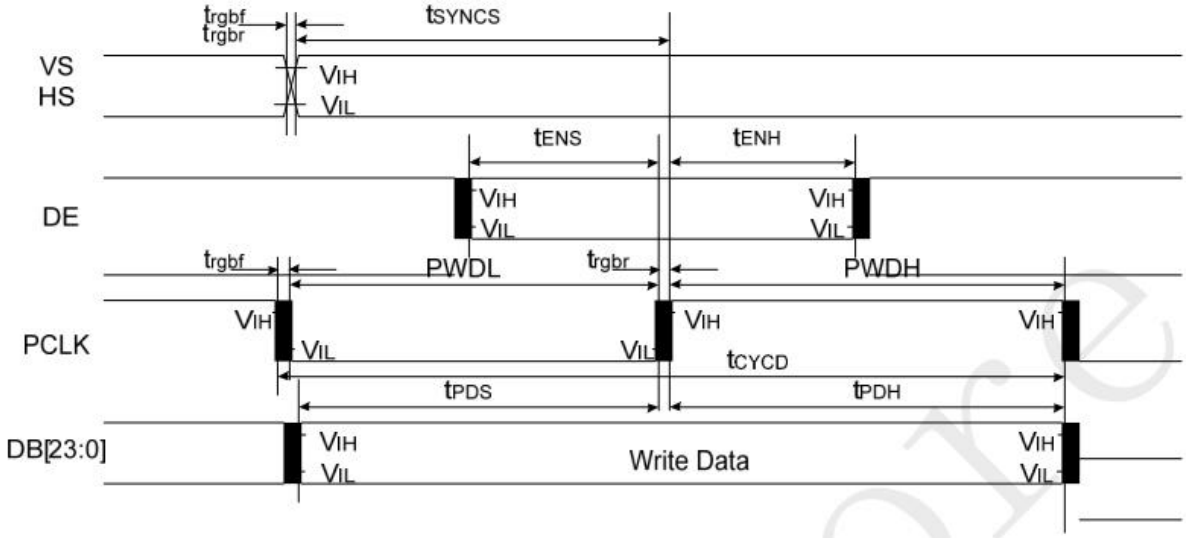


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	15	-	ns	
	tcsh	Chip select hold time (Read)	15	-	ns	
	tCHW	CS "H" pulse width	40	-	ns	
SCL	twc	Serial clock cycle (Write)	30	-	ns	
	twrh	SCL "H" pulse width (Write)	10	-	ns	
	twrl	SCL "L" pulse width (Write)	10	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL "H" pulse width (Read)	60	-	ns	
	trdl	SCL "L" pulse width (Read)	60	-	ns	
SDA/SDO (Output)	tacc	Access time (Read)	10	100	ns	For maximum CL=30pF
	toh	Output disable time (Read)	15	100	ns	For minimum CL=8pF
SDA/SDI (Input)	tds	Data setup time (Write)	10	-	ns	
	tdh	Data hold time (Write)	10	-	ns	

Note:

1. Ta = -30 to 70 °C, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, T=10+/-0.5ns.
2. Does not include signal rise and fall times.

5.5 Timing Diagram



Signal	Symbol	Parameter	min	max	Unit	Description
VS/ HS	t_{SYNCS}	VS/HS setup time	5	-	ns	24/18/16-bit bus RGB interface mode
	t_{SYNCH}	VS/HS hold time	5	-	ns	
DE	t_{ENS}	DE setup time	5	-	ns	
	t_{ENH}	DE hold time	5	-	ns	
DB[23:0]	t_{POS}	Data setup time	5	-	ns	
	t_{PDH}	Data hold time	5	-	ns	
PCLK	PWDH	PCLK high-level period	13	-	ns	
	PWDL	PCLK low-level period	13	-	ns	
	t_{CYCD}	PCLK cycle time	28	-	ns	
	t_{rgbr} , t_{rgbf}	PCLK,HS,VS rise/fall time	-	15	ns	

Note: Ta = -30 to 70 °C, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, DGND=0V

5.5.1 Timing Parameters

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Vertical low pulse width	VS	-	-	8	-	Line
Vertical front porch	VFP	-	-	12	-	Line
Vertical back porch	VBP	-	-	24	-	Line
Vertical active area	VDISP		-	960	-	Line
Vertical Refresh rate	VRR	-	-	60	-	Hz
HS low pulse width	HS	-	-	10	-	DCK
Horizontal back porch	HBP	-	-	20	-	DCK
Horizontal front porch	HFP	-	-	20	-	DCK
Horizontal active area	HDISP	-	-	400	-	DCK

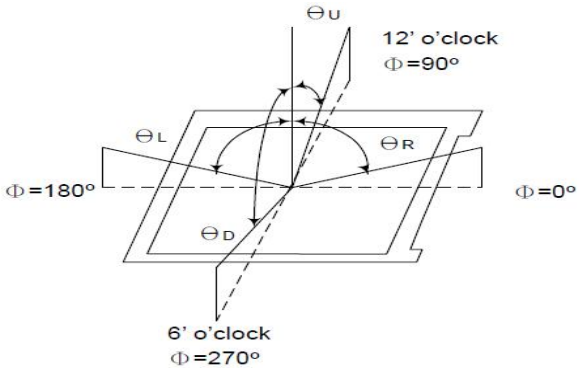
6. OPTICAL CHARACTERISTICS

Parameter 参数	Symbol 符号	Condition 条件	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Contrast Ratio	C/R	θ = 0°	1000	1500	-	-	Note(4)
NTSC Ratio	S	θ =0°	60	65		%	Note(7)
Luminance	L	θ =0°	-	350	-	cd/m2	Note(5)
Luminance uniformity	U_W	θ =0°	75	80	-	%	Note(3)
Response Time	T_R+ T_F	25 °C	-	30	40	ms	Note(2)
Color Coordination	W_X	θ = 0° (Center) Normal viewing angle B/L On	-+0.04	0.28	+0.04	NTSC (x,y)	Note(6)
	W_Y			0.32			
	R_X			0.647			
	R_Y			0.312			
	G_X			0.261			
	G_y			0.565			
	B_X			0.137			
	B_Y			0.11			
Viewing Angle	θ_L	C/R>10	80	85	-	Degree	Note(1)
	θ_R		80	85	-		
	θ_U		80	85	-		
	θ_D		80	85	-		

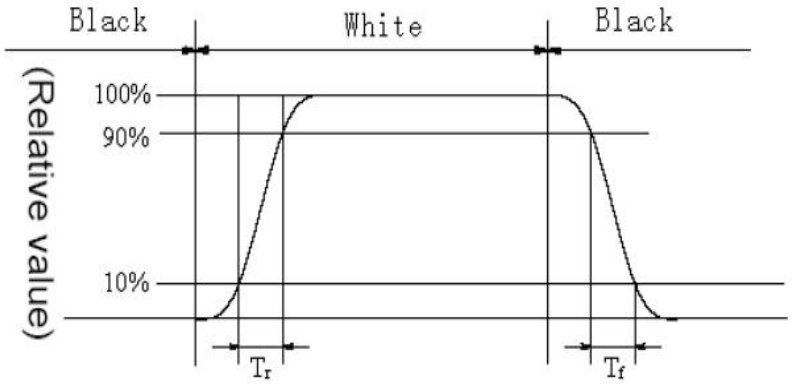
Test Conditions:

1. the ambient temperature is+25℃.
2. The test systems refer to Note 8.

Note1: Definition of Viewing Angle: The viewing angle range that the CR>10

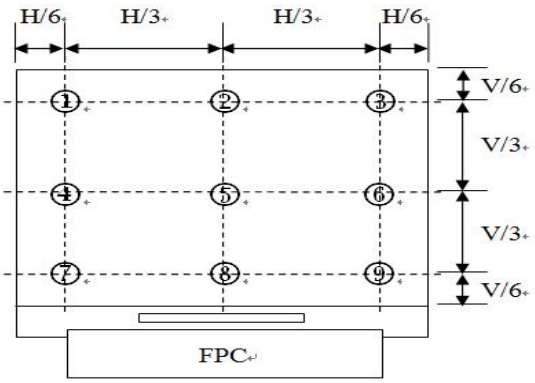


Note2: Definition of Response time: Sum of T_R and T_F



Note 3: Definition of Luminance Uniformity: Active area is divided into 9 measuring areas, every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity} = \frac{\text{Min Luminance of white among 9-points}}{\text{Max Luminance of white among 9-points}} \times 100\%$$



Note4: Definition of Contrast Ratio (CR): measured at the center point of panel

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

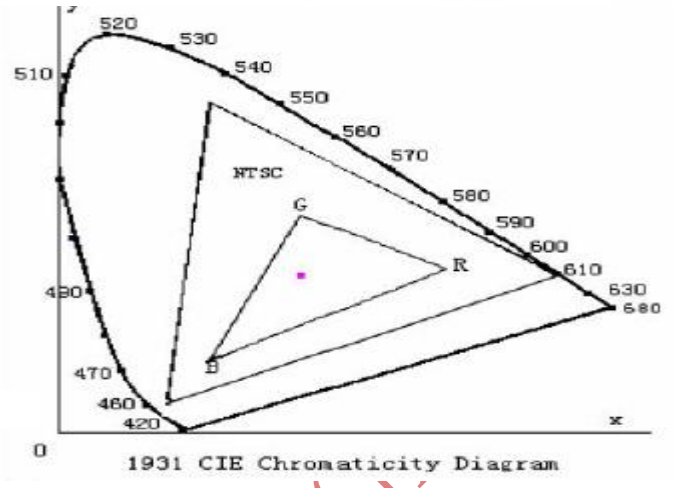
Note 5: Definition of Luminance: Center Luminance of white is defined as luminance values of 1point average across the LCD surface.

Note 6: Definition of Color Chromaticity (CIE 1931)

Color coordinates of white & red, green, blue measured at center point of LCD.

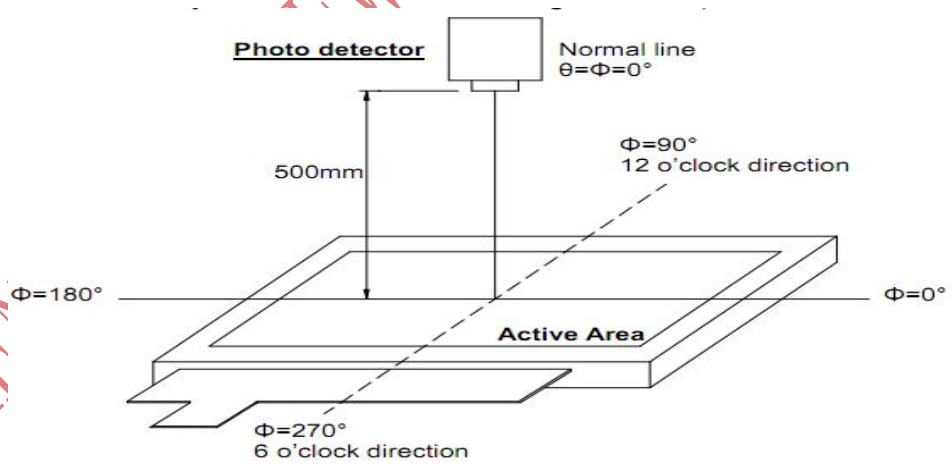
Note 7: Definition of NTSC ratio:

$$\text{NTSC ratio} = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}}$$



Note 8: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen.(Response time is measured by Photo detector TOPCON BM-7, Field of view: 1°/Height: 500mm.)



7. RELIABILITY

Item 项目	Test Condition 测试条件	Remark 备注
High Temperature Storage	Ta =+85°C / 4Hours	Note1,2,3
Low Temperature Storage	Ta =-30°C / 4Hours	Note1,2,3
High Temperature Operating	Ta =+85°C / 4Hours	Note1,2,3
Low Temperature Operating	Ta =-20°C / 4Hours	Note1,2,3
Temperature Cycle storage Test	-30°C/30min ⇆+80°C /30min for 30cycles,Transfer time less than 5min	Note2,3
Thermal humidity storage Test	60°C x 90%RH / 96Hours	Note2,3
Package Vibration Test	Frequency: 10Hz~55Hz,Amplitude:1.5mm, 1 hrs for each direction of X, Y, Z	Note2
Packing shock test	Drop to the ground from 1m height, 1 corner, 3 edges, 6 surfaces.	Note2

Inspection after Test:

Note1:Ta is the ambient temperature of samples.

Note 2: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but doesn't guarantee all the cosmetic specification.

Note 3: Before cosmetic and function tests , the product must have enough recovery time, at least 2 hours at room temperature.

8. PACKAGE DRAWING